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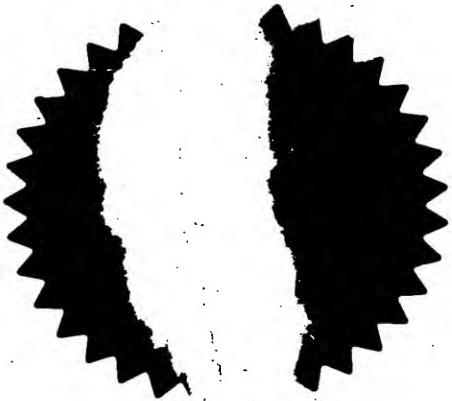
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Request for grant of a patent

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1. Your reference

gts.2930.uk.ac.k

2. Patent application number

(The Patent Office will fill in this part)

0407756.6

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
 Richard A. Armell
 "Nuestro Casa"
 Kirkton St. Cyrus
 Montrose
 ANGUS
 DD10 0BW

Alvin

AL 19-5-04

Patents ADP number *(if you know it)*

864592/001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

Downhole tool

5. Name of your agent *(if you have one)*
 "Address for service" in the United Kingdom
 to which all correspondence should be sent
(including the postcode)

 Kennedys Patent Agency Limited
 Floor 5, Queens House
 29 St Vincent Place
 Glasgow
 G1 2DT

0805 824 0002

Patents ADP number *(if you know it)*6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number <i>(if you know it)</i>	Date of filing <i>(day / month / year)</i>
GB	0312899.8	05/06/03

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing <i>(day / month / year)</i>
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
- any applicant named in part 3 is not an inventor, or*
 - there is an inventor who is not named as an applicant, or*
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No, Applicant is Inventor.

Patents Form 1/77

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Continuation sheets of this form

Description 11

Claim(s)

3

Abstract

1

Drawing(s)

5 4 + 4

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Priority documents

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Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination
(*Patents Form 10/77*)

Any other documents
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Kennedy

Date

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12. Name and daytime telephone number of person to contact in the United Kingdom

Arlene Campbell

Tel: 0141 226 6826

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1 Downhole Tool

2
3 The present invention relates to centralisers used to
4 centre tools in a tubular or well bore downhole. More
5 specifically, the invention relates to an expandable
6 centraliser which can centre a tool in an opening larger
7 in diameter than a diameter through which the centraliser
8 can freely pass.

9
10 When drilling or working on wellbores for use, for
11 example, in oil and gas exploration, it is desirable to
12 be able to increase the diameter of the well bore at a
13 location within the well. This is typically done below a
14 section of casing and thus a tool capable of being passed
15 through the casing, which has a first diameter, and
16 expanding to cut or mill out a bore having a diameter
17 greater than the first diameter must be used. Such tools
18 are referred to as underreamers.

19
20 Underreaming tools commonly comprise one or more pairs of
21 cutting blades which are moveable from a retracted
22 position to an extended position. The tool is maintained
23 in the retracted position so that it may pass through the

1 casing, it is then moved to the extended position and
2 held there by fluid pressure created in the drill string.
3 A disadvantage of these tools is that the two blade
4 arrangement provides 4 point contact on the walls of the
5 wellbore which does not centralise the tool when the
6 wellbore is inclined or horizontal.

7

8 Centralisers are known for centering tools in a wellbore.
9 The first type typically comprise a cylindrical body
10 sized to have a diameter approximately equal to the
11 diameter of the well bore at the location where the tool
12 needs to be centred. Unfortunately these centralisers
13 cannot pass through openings smaller than the diameter of
14 the well bore at the location where the tool needs to be
15 centred and therefore cannot be used to centre
16 underreamers.

17

18 A second class of centralisers comprise a cylindrical
19 body having longitudinally arranged spring bows
20 circumferentially around the body. These centralisers can
21 pass through openings as small as the diameter of the
22 body and then expand, by virtue of the bows, to
23 centralise themselves and a drill string in well bores of
24 larger diameters. However, due to the weight of the drill
25 string, these centralisers tend to 'drop' to the low side
26 of an inclined or horizontal well and thus loose their
27 centering ability in these environments.

28

29 It is an object of the present invention to provide a
30 centraliser for centering a tool in an opening larger in
31 diameter than the diameter of an opening through which
32 the centraliser can freely pass.

33

1 It is a further object of the present invention to
2 provide a centraliser which can centre a tool on a drill
3 string in well bores of any inclination.

4
5 It is a yet further object of the present invention to
6 provide an expandable centraliser which can centralise a
7 tool through a well bore of varying diameter.

8
9 According to a first aspect of the present invention
10 there is provided an expandable centraliser for centering
11 a tool in a well bore having an opening larger in
12 diameter than the diameter of an opening through which
13 the centraliser can freely pass, the centraliser
14 comprising a body connectable in a workstring, said body
15 having a bore running axially therethrough, said body
16 including a first portion being substantially cylindrical
17 with a substantially circular cross-section of a first
18 diameter and a second portion being polyhedral in cross-
19 section to provide a plurality of faces parallel to said
20 bore; a plurality of centralising members, each
21 centralising member being located on a said face; and
22 actuating means, said actuating means, on actuation,
23 moving said centralising members from a first position
24 within the first diameter to a second position wherein
25 portions of said members are located outside the first
26 diameter.

27
28 Preferably the second position is variable depending on
29 the actuation means and is preferably the diameter of the
30 larger opening.

31
32 Thus the centraliser is expandable so that the
33 centralising members can remain within the first diameter

1 for the centraliser to pass through a small opening and
2 can then be extended to contact a bore of a larger
3 diameter and hence centralise the tool.

4

5 Though the centraliser can operate with two centralising
6 members it is more preferably that there are three or
7 more centralising members. More preferably there are an
8 odd number of centralising members. Advantageously there
9 are three centralising members. This provides a simple
10 mechanical design.

11

12 Preferably the faces are identical and arranged
13 equidistantly around the body. Advantageously there are
14 three faces, providing a triangular cross-section, with a
15 centralising member arranged on each face.

16

17 Preferably each centralising member is pivoted against a
18 face. Thus on actuation, each member swings across the
19 face and extends from it. Preferably also a spring is
20 located at each pivot such that each member is returned
21 to the first position from the second position on removal
22 of the actuation.

23

24 Preferably the actuation means is a piston, the piston
25 having a leading end arranged to contact an operating
26 face of each centralising member, on actuation thereof.

27 Preferably the piston is hydraulically actuated. More
28 preferably the piston operates by differential fluid
29 pressure created in the work string.

30

31 The centraliser may include one or more intensifiers,
32 each intensifier comprises a first face perpendicular to
33 the bore having a surface area greater than an operating

1 surface area of the piston. Each intensifier may abut a
2 first face of a neighbouring intensifier to provide a
3 cascade. Preferably one intensifier is arranged to abut
4 the operating surface area of the piston. In this way the
5 centraliser can be operated in a work string having a low
6 fluid pressure at the centraliser as would occur if the
7 centraliser is located below a motor on the work string.

8
9 Preferably the second portion is arranged on a
10 cylindrical core of the body. In this way the first and
11 second portions can rotate independently of each other.
12 Thus in use, the first portion may rotate with the work
13 string while the centralising members remain stationary
14 in the wellbore.

15
16 An embodiment of the present invention will now be
17 described, by way of example only, with reference to the
18 following drawings of which:

19
20 Figure 1 is a cross-sectional view through an expandable
21 centraliser according to the present invention;

22
23 Figure 2 is an exploded view of the expandable
24 centraliser of Figure 1;

25
26 Figures 3(a) and (b) are part cross-sectional views
27 through the expandable centraliser of Figure 1 with the
28 centralising members in the (a) first and (b) second
29 positions; and

30
31 Figures 4(a) and (b) are views of the expandable
32 centraliser of Figure 1 in the (a) first and (b) second
33 positions.

1
2 Referring initially to Figure 1, there is illustrated an
3 expandable centraliser generally indicated by reference
4 number 10 in accordance with an embodiment of the present
5 invention. Centraliser 10 comprises a body 12 having a
6 first portion 14 which is substantially cylindrical and
7 defines the diameter of the centraliser 10. A further
8 portion 16 comprises a sleeve 18 mounted over a narrow
9 cylindrical portion 20. Mounted below the second portion
10 16 is a third portion 22 which is also substantially
11 cylindrical. At an upper end 24 of the centraliser 10
12 there is located a connector 26 for connecting the
13 centraliser 10 into a drill string (not shown). At a
14 lower end 28 of the centraliser 10, there is located a
15 threaded portion 30 for connecting the centraliser 10 to
16 a lower portion of a drill string (not shown). It will
17 be appreciated that the connectors 26, 28 can be used to
18 connect the centraliser 10 to a tool within a drill
19 string which requires to be centralised in the well bore.
20

21 The remaining components of the centraliser 10 are best
22 seen when Figure 1 is viewed in conjunction with Figure
23 2. Figure 2 illustrates an exploded view of the
24 centraliser 10 of Figure 1, like parts have been given
25 the same reference number to aid clarity. Centraliser 10
26 has an axial bore 32 passing through a centre axis from
27 the upper end 24 to the lower end 28 of the centraliser
28 10. Arranged from the lower end 28 there is located the
29 connector 30 and above this rests a sub 34 located around
30 the cylinder 20. Allen set screws 32 connect the sub 34
31 to the cylinder 20 so that they can rotate together.
32 Above the sub 34 is located a nylon spacer 38 protecting
33 thrust ball bearings 40. The bearings provide for

1 rotation of the sleeve 18 on the sub 34. Sleeve 18 has
2 an inner cylindrical surface 42. The inner surface 42
3 provides a smooth sliding relationship with the narrow
4 cylinder 20.

5
6 The outer surface 44 of the sleeve 18 comprises a
7 substantially triangular arrangement of three surfaces 46
8 a, b, c providing an equilateral triangle on the outer
9 surface 44 of the sleeve 18. Each face 46 a, b, c
10 includes a pivot 48 on which a centralising member 50 a,
11 b, c is located. A spring 52 located on the pivot 48 to
12 bias the members 50 to a longitudinal position where they
13 rest upon each face 46.

14
15 Each centralising member 50 comprises a paddle having an
16 aperture 54 for connection to the pivot 48, a rounded
17 edge 56 and an upper actuating edge 58. Edge 58
18 comprises two portions, a short planar portion 60 and a
19 sloping portion 62. The members 50 can be made of any
20 suitable material although they are preferably made of
21 stainless steel. Further they may be of any shape which
22 allows them, once arranged in a longitudinal position on
23 the face 46, to reside within the diameter of the upper
24 portion 14. The upper edge 58 of each member 50 rests
25 above the face 46 so that they can be acted upon by a
26 actuating surface 64.

27
28 The actuating surface 64 is a lower face of the upper
29 portion 14. Face 64 is arranged on a further nylon
30 spacer 66 with equivalent thrust ball bearings 68. The
31 face 64 can rotate independently of the sleeve 18 and
32 members 50. Above the spacer 66 is arranged a cam 70
33 which is acted upon by three cam pins 72 a, b, c. In the

1 embodiments shown, the cam pins 72 are attached to the
2 cam 70 for ease of operation. The cam pins 72 are
3 protected by an outer sleeve 74 arranged around the upper
4 portion 14 of the centraliser 10.

5

6 In the inner bore 32 above the cam pins 72 is located a
7 piston 76. Piston 76 includes two pairs of seals, 78, 80
8 to prevent fluid within the bore 32 leaking to other
9 portions of the centraliser on the outer surface 82 of
10 the piston 76. Piston 76 acts as an intensifier by
11 having a narrow portion 84 and a broader portion 86. In
12 this way an upper surface 88 is provided on the broader
13 portion 86 with a large surface area on which fluid
14 within the bore can act to operate the piston 76. It
15 will be appreciated that further pistons of this design
16 could be mounted above the piston 76, each with
17 decreasing narrower portions 84 and substantially greater
18 surface areas 88 so that fluid pressure on the upper
19 surfaces 88 increases the effective pressure on each
20 piston in turn.

21

22 Reference is now made to Figures 3 and 4 of the drawings
23 which illustrate the centraliser 10 in a first position
24 and in a second position operating position. Like parts
25 to those of Figures 1 and 2 have been given the same
26 reference numeral to aid clarity. In use, sleeve 18 is
27 located on cylinder 20 and the members 50 located on the
28 pivots 48. Cam 70 rests between the sleeve 18 and the
29 body 12 with the cam pins 72 inside the body 12 resting
30 against the piston 76. Threaded connector 30 is
31 connected to a drill string and preferably to a tool, for
32 example an underreamer in the drill string. The upper

1 connector 26 is connected to the remaining drill string
2 which may include a motor.

3
4 When in the well bore a low pressure is maintained
5 through the bore 32 such that the piston 76 is not
6 actuated. The cam 70 rests against the upper portion 14.
7 In this position, each member 50 is arranged parallel
8 with the bore 32 and remains substantially on a
9 respective face 46. The upper surface 60 of the member
10 50 rests against the actuating surface 64 of the above
11 portion 14. In this position the centraliser can be run
12 through a well bore casing which has a diameter equal to
13 or greater than the diameter of the upper portion 14.

14
15 When the underreamer has reached a position for operation
16 within the well bore, the underreamer can be centralised
17 by increasing fluid pressure through the bore 32. An
18 increase in fluid pressure provides a pressure
19 differential across the surface 88 of the piston 76.
20 Piston 76 is then forced downwards with the cam pins 72
21 driving the cam 70 in a downward direction such that the
22 actuating surface 64 contacts the surface 58 of each
23 member 50. As the actuating surface 64 is moving towards
24 the lower end 28 of the centraliser 10, the surface 58
25 will run on the surface 64 such that the contact with the
26 surface 58 will move from the small portion 60 to the
27 larger surface 62 of the member 50. As this movement
28 occurs the member 50 is forced to swing on the pivot 48
29 so that it moves cross the face 46 and extends from the
30 sleeve 18. A stop 90 limits the radial extension of each
31 member 50 by abutting to the surface 64. All members 50
32 a, b, c will move simultaneously as the piston 76 moves.
33 It will be appreciated that the outer edge 94 of each

1 member 50 will also limit the radial extent of the
2 centraliser as it abuts an inner surface of a casing or
3 well bore. In this way the centraliser 10 can be used in
4 a well bore casing of a variable diameter as each member
5 50 can dynamically move in response to pressure applied
6 at the surface 94. The pressure upon piston 76 ensures
7 that the members 50 are always in their most radially
8 extended position as required.

9

10 When work is finished in the well bore, pressure within
11 the bore 32 is dropped and as a result the piston 76 is
12 relaxed. The springs 52 move the members 50 back to
13 their longitudinal positions on each of the faces 46 of
14 the sleeve 18. The centraliser 10 can then be retracted
15 with the underreamer back through a small diameter
16 opening.

17

18 The principle advantage of the present invention is that
19 it provides a centraliser for centring a tool in an
20 opening larger diameter than the diameter of an opening
21 through which the centraliser can pass freely.

22

23 A further advantage of the present invention is that it
24 provides a centraliser which can centre a tool on a drill
25 string in wells of any inclination. This is because the
26 pressure applied on each of the surfaces 94 of the
27 members 50 is uniform and the members 50 are therefore
28 not inclined to drop to a lower side of the well bore.

29

30 It is a yet further advantage of the present invention in
31 providing a centraliser which can centralise a tool in
32 varying diameters of a well bore.

33

1 Various modifications may be made to the invention here
2 in described without departing from the scope thereof.
3 For instance though only three member 50 are shown on the
4 embodiment described it will be appreciated that any odd
5 number of members 50 may be used. Additionally, the only
6 single piston 76 is shown, identical pistons having
7 greater surface areas 88 can be sat up the piston 76 to
8 provide one or more intensifiers.

1 Claims:

2

3 1. An expandable centraliser for centering a tool in a
4 well bore having an opening larger in diameter than
5 the diameter of an opening through which the
6 centraliser can freely pass, the centraliser
7 comprising a body connectable in a workstring, said
8 body having a bore running axially therethrough,
9 said body including a first portion being
10 substantially cylindrical with a substantially
11 circular cross-section of a first diameter and a
12 second portion being polyhedral in cross-section to
13 provide a plurality of faces parallel to said bore;
14 a plurality of centralising members, each
15 centralising member being located on a said face;
16 and actuating means, said actuating means, on
17 actuation, moving said centralising members from a
18 first position within the first diameter to a second
19 position wherein portions of said members are
20 located outside the first diameter.

21

22 2. An expandable centraliser as claimed in Claim 1
23 wherein the second position is variable depending on
24 the actuation means.

25

26 3. An expandable centraliser as claimed in Claim 1 or
27 Claim 2 wherein there are three or more centralising
28 members.

29

30 4. An expandable centraliser as claimed in Claim 3
31 wherein there are an odd number of centralising
32 members.

33

- 1 5. An expandable centraliser as claimed in any
2 preceding Claim wherein the faces are identical and
3 arranged equidistantly around the body.
- 4
- 5 6. An expandable centraliser as claimed in Claim 5
6 wherein there are three faces, providing a
7 triangular cross-section, with a centralising member
8 arranged on each face.
- 9
- 10 7. An expandable centraliser as claimed in any
11 preceding Claim wherein each centralising member is
12 pivoted against a face.
- 13
- 14 8. An expandable centraliser as claimed in Claim 7
15 wherein a spring is located at each pivot such that
16 each member is returned to the first position from
17 the second position on removal of the actuation.
- 18
- 19 9. An expandable centraliser as claimed in any
20 preceding Claim wherein the actuation means is a
21 piston, the piston having a leading end arranged to
22 contact an operating face of each centralising
23 member, on actuation thereof.
- 24
- 25 10. An expandable centraliser as claimed in Claim 9
26 wherein the piston is hydraulically actuated.
- 27
- 28 11. An expandable centraliser as claimed in Claim 10
29 wherein the piston operates by differential fluid
30 pressure created in the work string.
- 31
- 32 12. An expandable centraliser as claimed in any
33 preceding Claim wherein the centraliser includes one
34 or more intensifiers, each intensifier comprising a

1 first face perpendicular to the bore having a
2 surface area greater than an operating surface area
3 of the piston.

4

5 13. An expandable centraliser as claimed in Claim 12
6 wherein each intensifier abuts a first face of a
7 neighbouring intensifier to provide a cascade, and
8 wherein one intensifier is arranged to abut the
9 operating surface area of the piston.

10

11 14. An expandable centraliser as claimed in any
12 preceding Claim wherein the second portion is
13 arranged on a cylindrical core of the body so that
14 the first and second portions can rotate
15 independently of each other.

16

1 Abstract:

2

3 An expandable centraliser, having a body with a first
4 portion of circular cross-section and a second of
5 polyhedral cross-section. Plates are arranged on faces
6 of the polyhedral portion which, in a first position,
7 limit the diameter of the tool so that it may pass
8 through small openings in a well bore. The plates can
9 then move across the faces hydraulically, to extend and
10 provide supports for the centraliser in larger openings
11 within the well bore.

12

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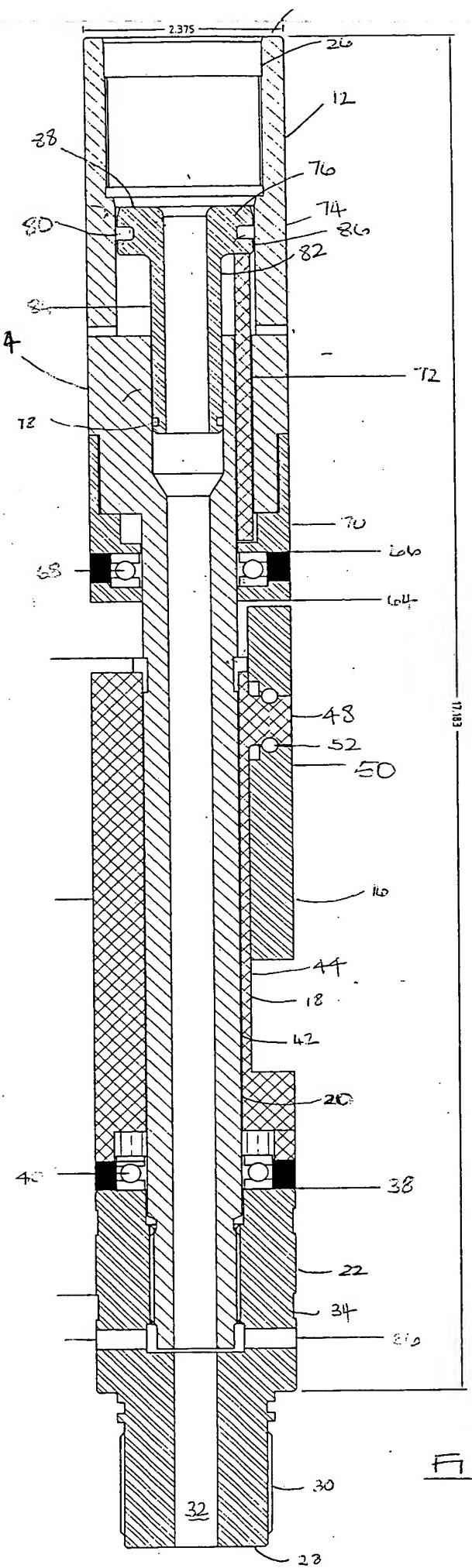


FIGURE 1

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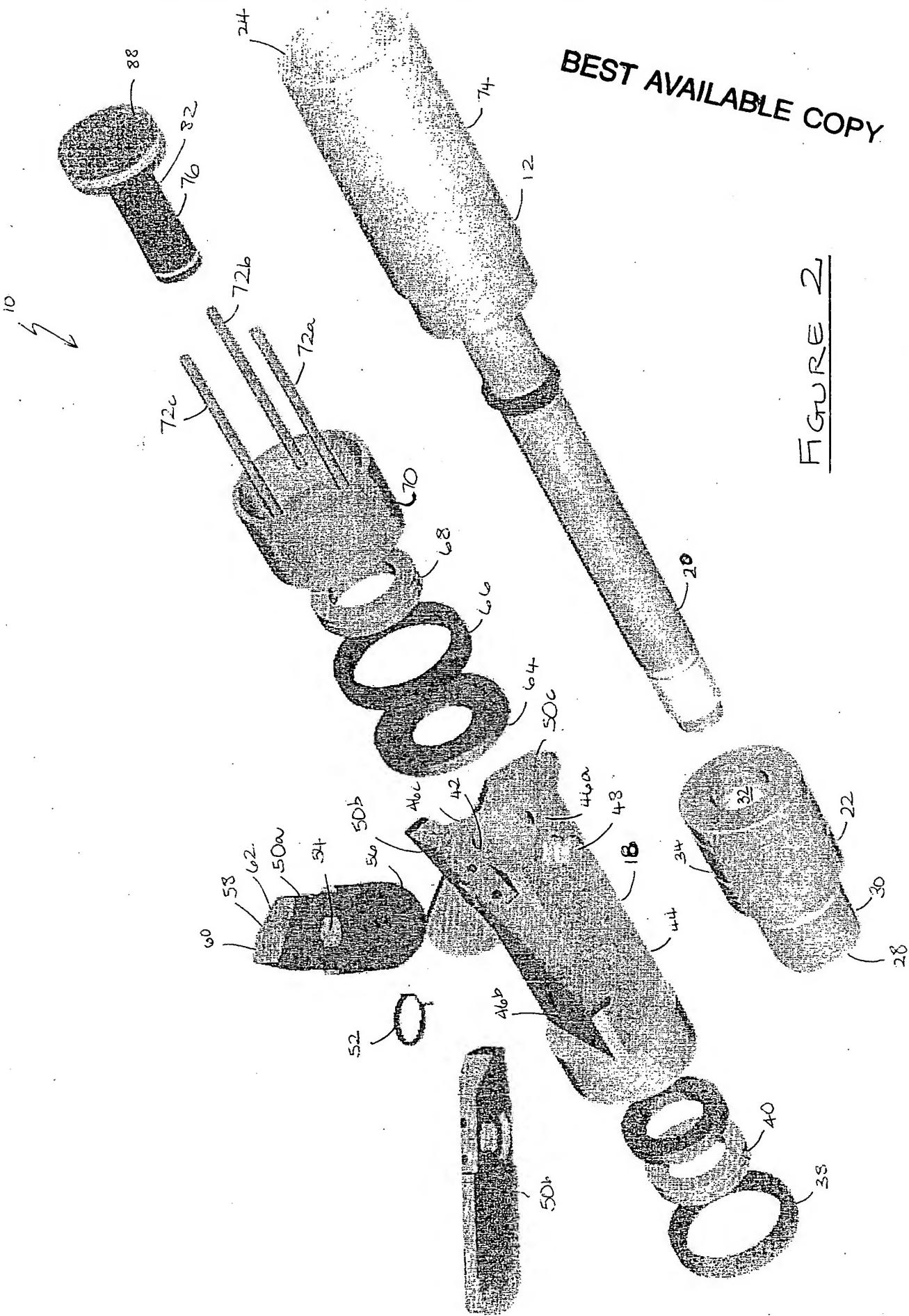
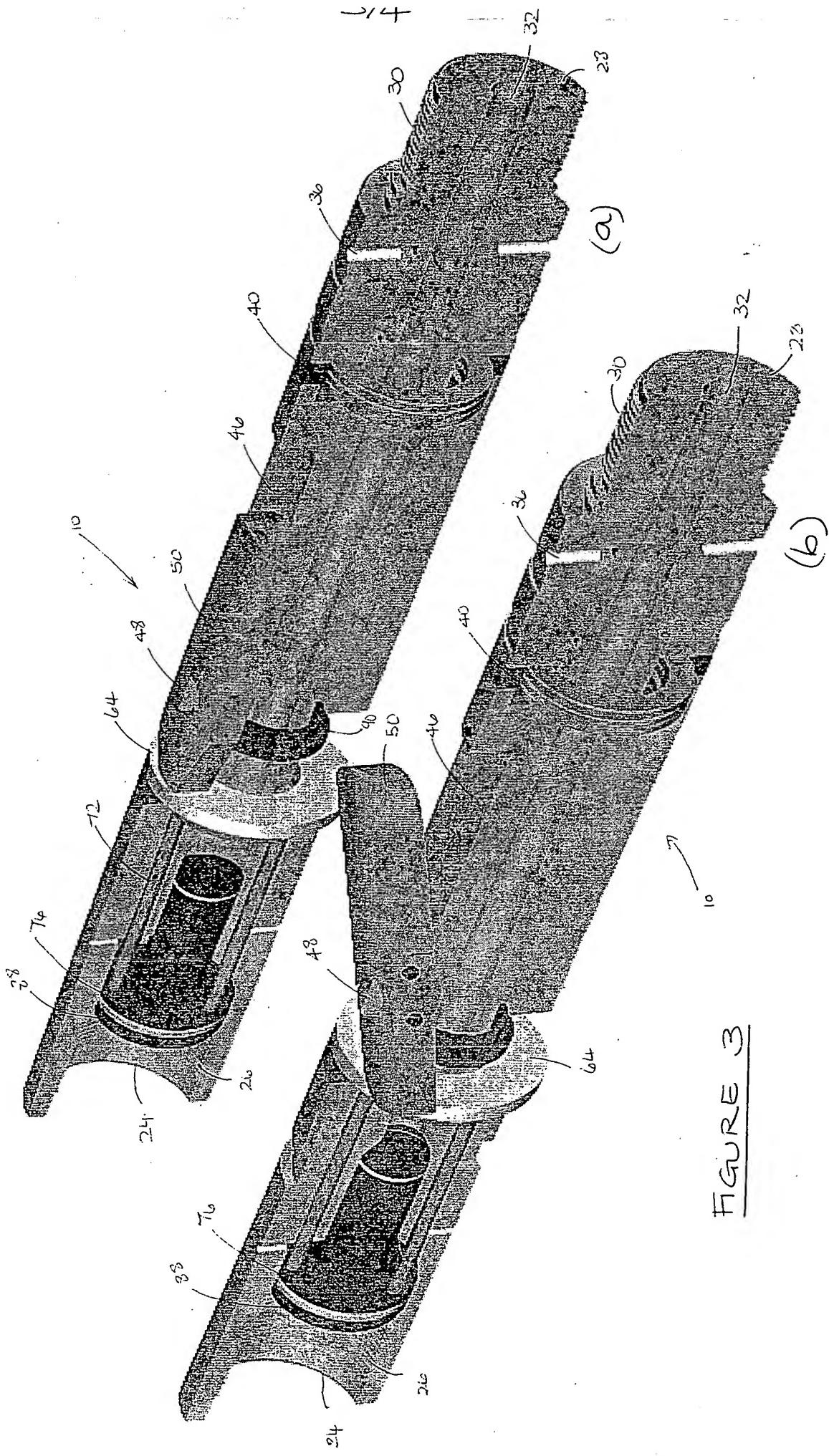


FIGURE 2

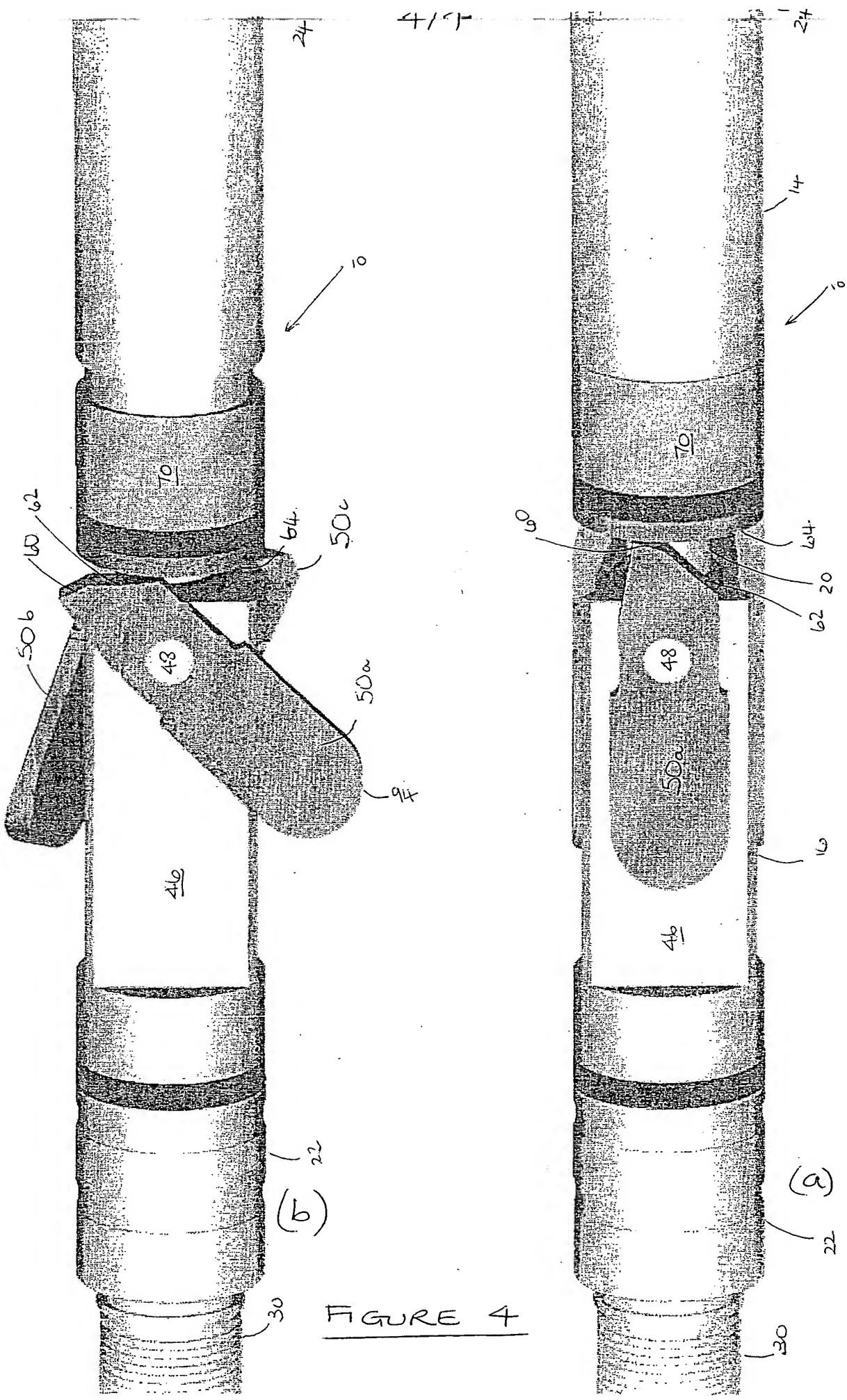
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